THE CLEAN COAL INITIATIVE: AN APPROPRIATE RESPONSE TO COMPLEX ENVIRONMENTAL ISSUES

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INTRODUCTION

Little effort is required to confirm the importance of coal as a fuel source for meeting the increasing demands for energy both in the U.S. and internationally. Performing such an exercise would establish that the U.S. should be preparing to use twice as much coal representing an increase in its share of total U.S. energy consumption from today's 34 percent to about 40 percent over the period between now and the middle of the next century.

The challenge is not whether coal will be used, but to assure its use is accomplished in the most efficient way and with the least impact on the environment. Environmental requirements have joined cost reduction as the primary driving forces pushing coal technology development in new directions. A responsive and successful technology development program is essential to realizing sustainable economic and environmental development of our coal reserves on a domestic as well as on a global basis.

TECHNOLOGY DEVELOPMENT

It is an inconvertible fact that the uncontrolled burning of coal will release into the environment carbon dioxide (CO_2), sulfur dioxide (SO_2), oxides of nitrogen (NO_x), particulate matter, and ash. The relative amounts of these emissions will be determined by the amount of coal burned and the effectiveness as well as the degree to which some type of controls are used. The CCTs create the capability to utilize coal as an energy resource with attendant minimal emissions of these pollutants.

Suitably developed CCTs thus provide a unique opportunity to concurrently satisfy two national goals. These are to:

(a) Continue the substantial progress made in emission reductions by resolving the conflicts between coal use and environmental protection.
(b) Meet the rapidly approaching electricity capacity challenge with reduced cost and increased productivity.

Recognizing that in the U.S. 85 percent of all coal produced provides about 60 percent of the Nation's electricity, development of CCT is pursuing two primary objectives. These objectives are to:

(a) Provide an array of retrofittable emission control options which satisfy, at reduced cost the void between present physical coal cleaning capabilities and flue gas scrubbing for existing powerplants.
(b) Provide improved coal utilization alternatives for both repowering and new plant application. Of particular significance are fluidized-bed combustion and coal gasification/combined cycles which combine high levels of emission and effluent control with reduced cost and improved efficiency.

On a global basis, the importance of this linkage between technology development, electricity, coal utilization, and the environment was underscored by the Conservation Commission of the World Energy Conference which stated that:

(a) Future global economic growth particularly in the developing regions will be associated with very large increases in electricity growth.
(b) Coal which provides over 80 percent of the world's nonrenewable energy resource will become increasingly prominent in the coming decades. Worldwide coal usage is expected to exceed the use of petroleum during the first decade of the next century and to continue its preeminence during at least the following 50 years.
(c) Technological innovation to support this expansion in coal use will be essential for the world's economy and its environment.*
(d) The geopolitical importance of coal and the technology for its use are also likely to increase substantially since the bulk of the world's coal resources is controlled by the U.S., U.S.S.R., and China.

*Underlining emphasis added.

These assessments reflect the unique opportunity that low cost, widely distributed coal has to become the source of a versatile, highly available energy form--electricity. Electrification has become a global economic imperative. Growth in electric power production is a major consideration in global energy and environmental projections.

While in the past, the pace of the required advancements in coal utilization technology has proceeded at a acceptable rate, new constraints including escalating capital costs, declining construction productivity, new licensing requirements and growing environmental concerns has shown that a fundamental change in the development of coal-fired technology is required. A principle now being used to guide CCT development is that sustained environmental improvement can only be realized when both emission and cost reduction are achieved concurrently, not pitted against each other.

CLEAN COAL TECHNOLOGY DEVELOPMENT

The importance of these factors in developing an appropriate strategy for the use of the immense coal reserves of the U.S. has been recognized. Positive steps have been taken to ensure that new concepts for the utilization of coal are available to respond to future needs.

The Clean Coal Initiative is one of the largest technology development efforts now underway in the Department of Energy (DOE) . The level of funding responds directly to the strategic importance of coal in the U.S. economy and

the international marketplace and recognizes the need to develop solutions for the problems (economic and environmental) associated with meeting increased demand for this source of energy.

It is an accepted fact that the present and near term future of coal as an energy source depends upon continued advances in coal utilization technology.

The CCT Demonstration Program itself is a technology development effort jointly funded by the Government and industry. In this program, the most promising of the advanced coal based utilization technologies are being moved into the marketplace through demonstration. The demonstration effort is at a scale large enough to generate all data needed by the public sector to judge the commercial potential of the processes being developed. As a goal, the program will make available to the U.S. energy marketplace a number of advanced, more efficient, and environmentally responsive coal utilization technologies. These technologies will reduce or eliminate the economic and environmental impediments that limit the full use of coal.

The program as planned, currently consists of five phases (rounds). It is entering the fourth of the five planned phases. The first three phases were competitive solicitations in which 35 projects with an estimated total cost of $3.7 billion were selected. Of these projects, 29 have been started under the terms of cooperative agreements between the participants and the Government and negotiations are in progress on the remaining six. Of particular importance to DOE in these projects is the level of financial participation of the private sector. Although the U.S. Congress, in its guidance to the program, requires that such participation be a minimum of 50 percent, the participants are providing 63 percent of the funds for the projects in the cooperative agreements signed to date.

The fourth phase of the program has been initiated. The fourth competitive solicitation was released on January 17, 1991, with additional projects to be selected in 1991. Funding in the amount of $600 million each for phases IV and V have been appropriated. When the five phases of the program are completed, two major objectives will have been accomplished:

1. A wide range of more efficient, environmentally responsive coal utilization processes will be available for use that will accommodate almost every combination of specific site requirements.

2. Acid rain precursor emissions will be significantly reduced and significant reductions will have been made in the amounts of CO_2 generated as a result of using coal as an energy source.

WHAT ARE CLEAN COAL TECHNOLOGIES?

This description of something called the CCT Program has little meaning in the absence of some idea about what CCTs are and what type of benefits can be achieved through their use.

The term "clean coal" in itself is to some a conflict in terms. The image of coal certainly is not consistent with "clean." When CCTs are discussed, these

discussions are about advanced coal based utilization systems that offer significant benefits when used for power generation, pollution control, or the conversion of coal into other alternate energy products.

First in the area of power generation, the characteristics of these technologies such as improved thermal efficiencies, modular construction, improved environmental performance, fuel flexibility, repowering capability, etc., will help the power industry accommodate a time of significant change caused by such factors as regulatory reform, uncertain growth in power demand, environmental pressures, and now competition from Independent Power Producers and Cogenerators.

Second, the name clean coal emphasizes its role in pollution control. In this case, most generally through a retrofit application, the technologies can directly remove SO_2 and NO_2 acid rain precursors and substantially reduce the amount of CO_2 generated when combusting coal. The specific type and amounts of pollutants removed will be a characteristic of the individual process. It should be noted also, however, that some CCTs (e.g., Pressurized Fluidized-Bed Combustion (PFBC), Integrated Gasification Combined Cycle (IGCC) have the ability to remove these pollutants while at the same time increasing the power output of the facility itself from 50-150 percent.

In the third case, CCTs can create the opportunity to produce coal derived liquid fuels to replace oil and gas in some applications. This capability will permit coal to have a greater role in providing energy to the industrial, commercial, and transportation sectors.

IMPACT OF THE PROGRAM

With the CCT Demonstration Program implemented to only 60 percent of its proposed full potential, it is premature to evaluate the degree to which it will achieve its objective of making available the technology that will permit the increased use of coal in an environmentally acceptable manner. However, it is not premature to examine the program's accomplishments to date to see how well it is progressing toward that objective.

Thirty-five projects representing ten major categories of technology are in various stages of design, construction, and operation. These projects represent a cost shared effort of private industry and government to achieve mutual objectives. The interest of the private sector in the potential benefits of the program is reflected in a level of cost sharing significantly higher than the required 50 percent (i.e., 63 percent). The technologies being developed are capable of being responsive to the demands of the utility sector for retrofit as well as repowering solutions and key components of industry have used the opportunity to address major pollution issues that threaten their continued existence from an economic and environmental point of view.

The retrofit technologies in the program include six innovative processes for the reduction of sulfur dioxide, six processes for the control of nitrous oxides and six new concepts for their simultaneous removal. These processes introduce combustion modification techniques, new as well as state-of-the-art absorbents employed in new applications and the development and use of new generations of catalysts.

The potential for increased power output is combined with emissions control in the suite of seven repowering technologies being developed. Such promising concepts as pressurized fluidized-bed combustion, coal gasification, circulating fluidized-bed combustion, both atmospheric and pressurized, will be operated as part of a number of innovative integrated power generation systems. These systems offer the potential of increasing the power output of a facility from 50-150 percent, while achieving significant reduction in SO_2 and NO_x emissions.

The three advanced combustor projects are generating new economic systems for coal utilization in both the utility and industrial sectors and the advanced pollution control processes being developed for the steel and the cement industry offer significant and perhaps essential economic solutions to major environmental obstacles.

Finally, a number of projects are introducing the possibility of fuel flexibility through the conversion of coal. While the conversion of coal into other fuel forms is not a new concept, the introduction of environmental issues in conjunction with economic considerations creates a challenge that is being addressed by three of the projects in the Clean Coal Program.

These projects represent options to the utility and industrial user that can accommodate a wide range of site specific requirements to become the solution to emissions control and power production problems.

The role that the technologies play in the reduction and control of acid rain precursor emissions is clearly evident. However, the significant role that some of the technologies can play in resolving some of the complex issues of global warming is not so evident.

Global warming is a critical environmental issue gaining international attention. It focuses on the possibility of significant changes in global climate as a consequence of changes in atmospheric concentrations of "greenhouse" gases--most notably carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and chlorofluorocarbons (CFCs).

The question of whether the earth is really warming because of the generation of these greenhouse gases is still a matter of considerable debate and scientific analyses. Moreover, there are significant questions about the relative contributions of various human activities. Nevertheless, if scientific evidence ultimately shows that remedial actions are necessary to mitigate climate change, technology innovation and development is an alternative strategy to regulatory constraints.

Some of the projects now in the CCT Program are developing technologies that can cut the emission of "greenhouse" gases in two fundamental ways. First, many of the CCTs improve the efficiency of the conversion of coal to useful energy. Technologies such as pressurized fluidized-bed combustors, integrated gasification combined-cycle systems, and fuel cells will consume less coal per unit of useful energy produced and thus reduce CO_2 emissions. Second, low-NO_x burners, selective catalytic reduction, and other technologies will reduce NO_x emissions, which should reduce N_2O formation.

As global warming becomes an increasingly important issue, the reduction of emission of greenhouse gases will increase in priority, and the worldwide commercial deployment of CCTs will take on even greater significance.

AN APPROPRIATE RESPONSE

The success achieved thus far in the CCT Program as represented by the number of projects, the degree of industrial participation, and range of technologies included, certainly argues well for the potential of the technology development effort and the possibility of it achieving all of its technical objectives.

The 35 projects that are now underway are equally as significant for the promise they offer in generating solutions to a number of the complex interrelated issues of energy, economics, and the environment. These projects and others to follow permit the continued use of coal as an energy source while:

- Being responsive to the requirements of the Clean Air Act Amendments.
- Reducing the amount of acid rain precursors generated during combustion.
- Improving the ability of the utility industry to meet increased demands for power in a cost effective manner.
- Contributing significantly to improved control over carbon dioxide emissions and thus addressing the issue of global warming.
- Providing environmental control options to accommodate a wide range of specific site requirements.

These capabilities certainly indicate that the CCT Demonstration Program can provide appropriate responses to a wide range of complex environmental issues.